TREATMENT OF TIMBER

By F. S. Crawford and J. Howard Bird

* * * * * * * * * * **Information Circular 7597**

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
James Boyd, Director

Work on manuscript completed October 1950. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Information Circular 7597."

March 1951

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by

F. S. Crawford[2/] and J. Howard Bird[3/]

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1/ Paper presented to the Mining Section, National Safety Congress, Chicago, Ill., Oct. 16-19, 1950.

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GENERAL INFORMATION

Untreated timber in a mine or elsewhere may fail prematurely because it may "rot out before it wears out." If such timber is treated with a satisfactory preservative, decay will be retarded for many years, and it's serviceable life will be prolonged to several times that usually obtained from untreated timber.4/ Treated timber has many advantages, and although it has been used extensively by railroads and other large consumers of structural timber, the relatively small use in mines seems strange indeed.

Timber does not decay if it is kept dry, cool, and well-ventilated5/ or if it is kept constantly wet or sumberged in water. At a mine in Canada the temperature in the upper levels was only 44° F., and the timber did not decay. As operations deepened, however, warmer ground was opened, and, with high humidity, conditions favored timber decay. The life of untreated timber may be only 2 to 3 years under such conditions.

Under present conditions, using time-tested treatment methods, installation of treated timbers is justified even if only one replacement is avoided. In 1946 the cost of a set of 12-inch diameter timber installed in a mine in Michigan was $14.66.6/ The cost of a set treated with chromated zinc chloride by the hot-and-cold bath process was $18.82. The additional expenditure of $4.16 obviated a replacement charge of $14.66 after 3 years, saving $10.50. Depending on labor and material costs, additional savings would be realized in the 6th, 9th, and 12th years if the place in the mine lasted that long. Additional savings in costs accrue from avoiding removal of old timber and transportation and delays in operation during repair work.

Preservatives increase the life of the wood and reduce the danger of fire (if creosote or similar preservatives are not used) by keeping the wood sound.4/ Sound wood is harder to ignite than partly decayed wood and will withstand heat and flame longer without failure.5/ Decayed timber may fail suddenly; therefore, it is more likely to cause accidents than sound timber. The strength of a timber will be reduced greatly by decay. A timber may appear sound to the casual observer but actually it may be in dangerous condition. Treatment of a timber with a preservative also helps to maintain its inherent strength longer than that of an untreated timber.

4/ Horner, R. R., and Tufft, H. E., Mine Timber: Its Selection, Storage, Treatment, and Utilization: Bureau of Mines Bull. 235, 1925, 118 pp.

5/ Keeley, D. E., The Preservation of Timber by Chemical Treatment at McIntyre Mines: American Wood Preservers' Association, 1949.

6/ Crawford, F. S., and Wirka, R. M., A Test of Treated Timbers in a Mine at Negaunee, Mich.: Bureau of Mines Rept. of Investigations 4622, 1950, 6 pp.

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The methods of treating timber are well-described in Bureau of Mines Bulletin 235,4/ and are grouped as pressure and nonpressure processes. Pressure methods are more expensive than nonpressure methods but produce more uniform and better results. Of the nonpressure methods, the hot-and-cold-bath method is the best. Other nonpressure methods are steeping, dipping, brush treating, and spraying. Results attainable from the various methods usually are directly proportional to the expense of treatment.

The introduction of another method of treating mine timber was suggested by the results of tests7/ made in California at the Forest Insect Laboratory of the Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. For the past 20 years the Division of Forest Insect Investigations has experimented with the injection of chemicals into the sapstream of green trees to prevent decay and injury by insects. Chemical impregnations of trees and poles by sapstream methods have been tried in one form or another for centuries.8/ Strictly for wood preservation, however, the methods had not been acceptable because they were commercially inadequate. Most of the experimental work was done in the East and South, but some was done in the West. One of the experiments was carried out in California during the period 1937 to 1950.

Trees of several species ranging in diameter from 8 to 20 inches, classed as poles and posts, and in height from 20 to 90 feet were treated with various chemicals by several methods, utilizing the natural transpiration action of the foliage in drawing the sap to the top of the tree. The chemical in solution mixed with or replaced the sap and followed the sapwood to the foliage. None of the chemical entered the heartwood or the bark. As the method depends on the flow of sap to carry the chemical, it is most effective when applied to vigorous, healthy trees and must be applied when the sap is flowing. As the bark is not affected by the treatment, it may remain intact on mine timbers cut from such trees and protects workmen from contact with poisonous chemicals when handling timbers.

The chemical compounds used in tree-injection doses included both organic and inorganic substances, and all were in water solutions. Some chemicals require more water than others to provide a solution that may be injected properly. Chemicals used in the tests were copper sulfate, ammonium bifluoride, sodium arsenite, zinc chloride, copper carbonate with ammonium hydroxide, and tetrachlorophenol.

CONDUCTION AND DISTRIBUTION OF CHEMICALS IN TREE STEMS

The rate and extent of conduction through the tree stems varied with the different chemical compounds. Ammonium bifluoride was outstanding in both

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7/ Patterson, John E., Some Results of Chemical Impregnation of Pole-Sized Trees to Prevent Insect Attack and Decay: Rept. 6-23-50, Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture, Berkeley, Calif.

8/ Wilford, B. H., Chemical Impregnation of Trees and Poles for Wood Preservation: Division of Forest Insect Investigations, Circ. 717, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture, 1944.

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Figure 1. - Tree injection by tub method.

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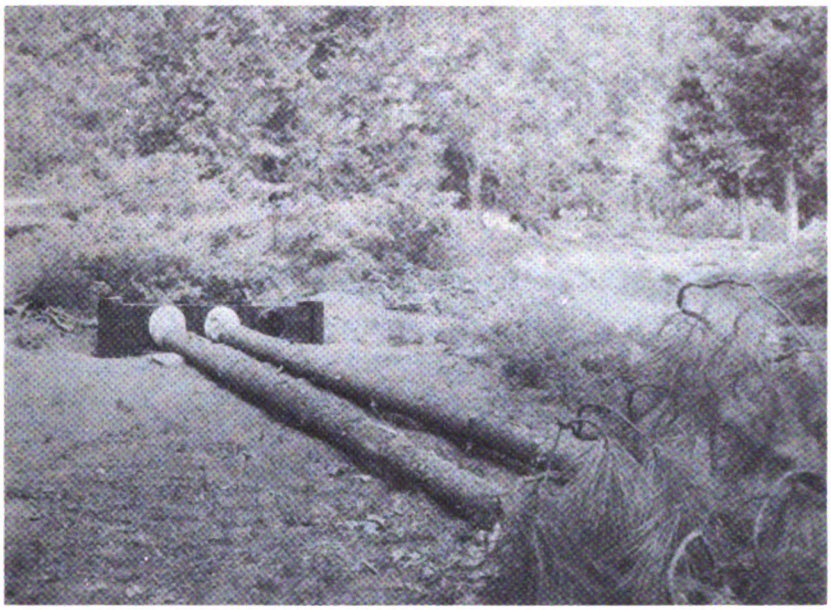

Figure 2. - Set-up of tank-pressure method for treating cut trees.

Figure 3. - Close-up of collar and tank connection for treating cut trees.

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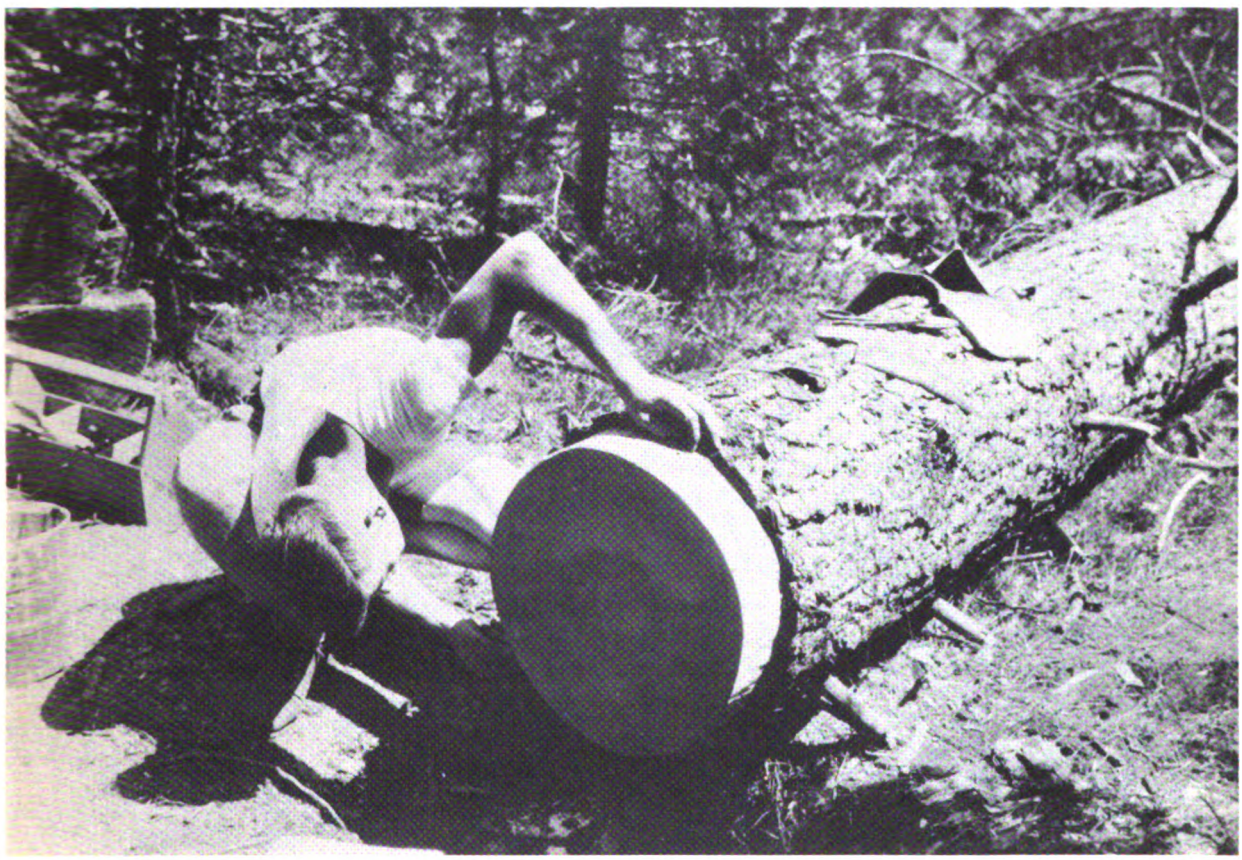

Figure 4. - Preparing end of tree for collar method of injection.

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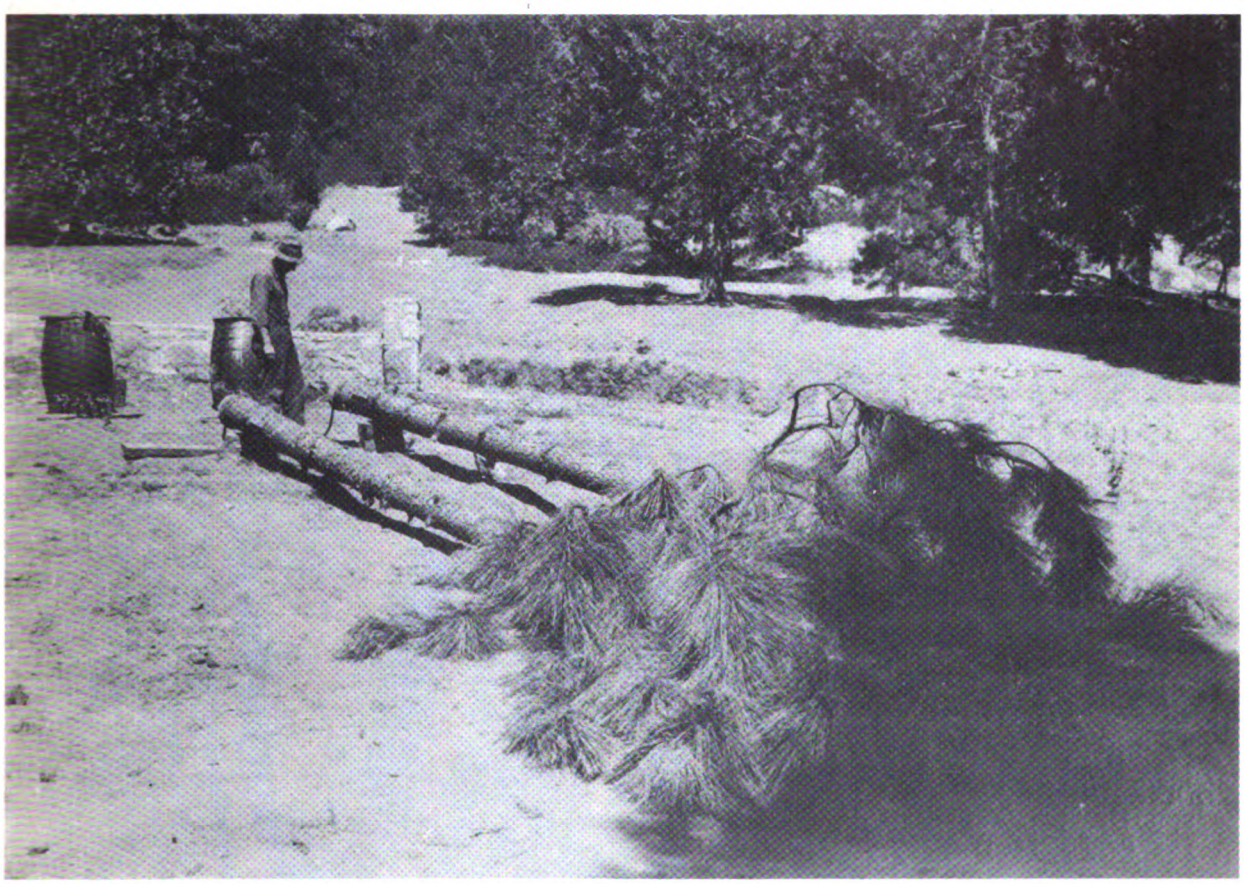

Figure 5. - Cut trees attached to barrel-type reservoirs for injection by collar method.

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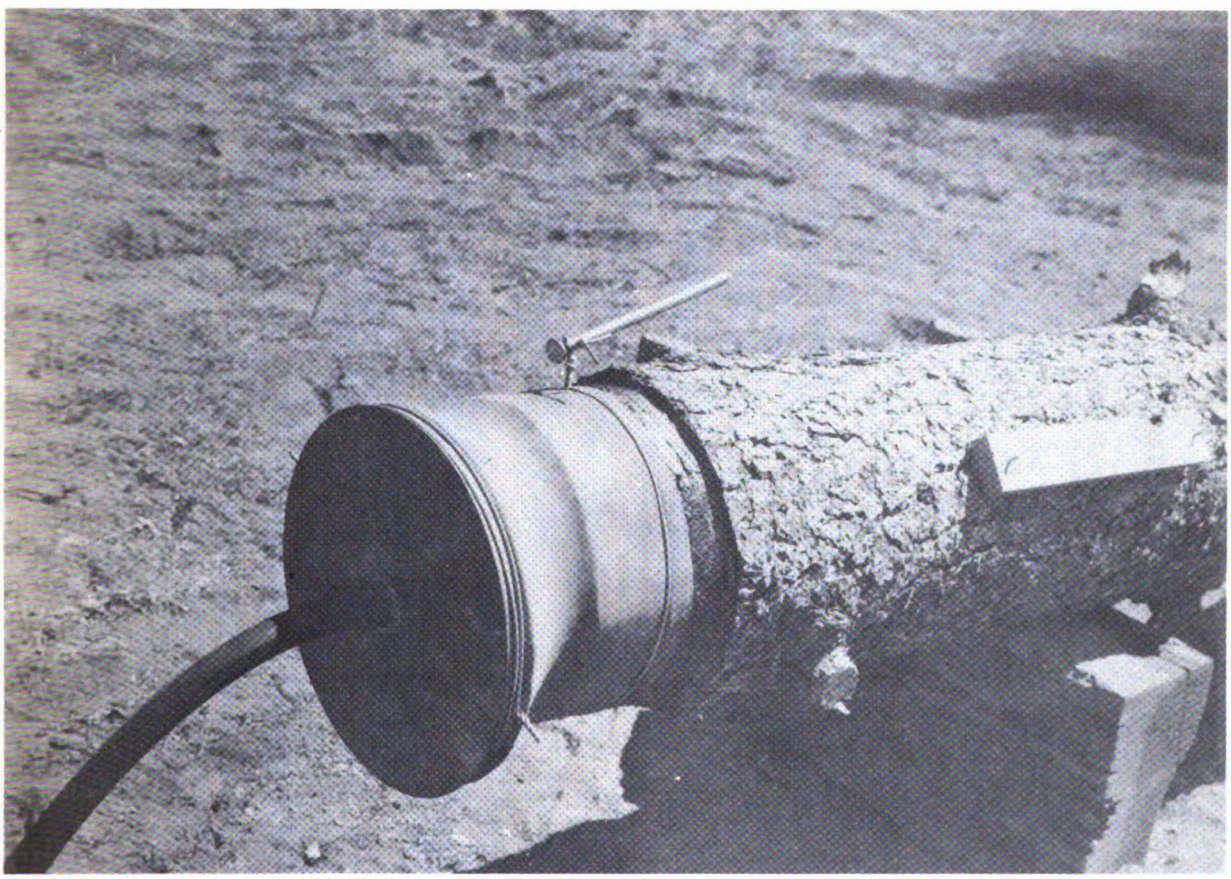

Figure 6. - Close-up of end of cut tree showing disk, rubber collar, and hose connections for injection by collar method.

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Figure 7. - Cut-tree injection by cap method, using central reservoirs.

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Figure 8. - Sawing kerf girdle for injection of standing tree by saw-kerf and collar method.

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Figure 9. - Attaching collar to standing tree prior to injection by saw kerf and collar method.

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Figure 10. - Erecting demonstration log building to test durability of chemical-injected logs.

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rate and extent of conduction, because the time required for complete absorption of the full doses of ammonium bifluoride was less than half that required by any other chemical. Sodium arsenite and zinc chloride were second in effectiveness. Copper carbonate and the chlorinated phenols were at the lower end of the scale, requiring 6 to 10 days for complete absorption. Copper sulfate was conducted readily, but so much water is required to keep it in solution that the volume of prescribed doses was excessive - 30 to 40 gallons for the larger trees - 7 to 8 days being required for the average tree to absorb such a quantity. The maximum time required with copper carbonate and the chlorinated phenols was as much as 10 days. In contrast, the time of conduction with ammonium bifluoride and sodium arsenite was as low as 8 to 10 hours. When conduction was complete for the full length of stem, the distribution of chemical was thorough and uniform for the entire sapwood with all chemicals used. All the chemicals were effective in preventing decay and rot due to fungi. All the compounds except zinc chloride and the chlorinated phenols were toxic to bark beetles and wood borers.

The method of chemical impregnation depended on movement of water solutions through the sapstream of green trees - a well-known phenomenon. The mechanical methods for attaining this result were identical in effect but differed in specifications. They are briefly described as follows:

1. Tub method. - Trees were cut at stump height, and the cut base was placed in a tub containing the chemical injection dose. During treatment the trees were held in an inclined position against nearby uncut trees (fig. 1). Conduction of the dose was accelerated by transpiration through the needles, which were left intact on the crown. This method was confined to small trees because of difficulty in handling the weight of large trees.

2. Collar and capping methods. - With these methods the trees were cut at stump height but were treated in horizontal position on the ground. The kerf ends of the stems were encased in funnel-shaped rubber tubes, which were attached to several kinds of reservoirs containing injection doses. Limbs and foliage were left intact to facilitate transpiration and chemical conduction. This method was used for both pole-size and larger tree stems (figs. 2 to 7, inclusive).

3. Saw-kerf and collar method. - In this method trees are treated in standing position and are not disturbed in any way except for removing the bark for several feet and making a deep saw kerf at stump height entirely encircling the trunk and severing the sapwood. To contain the injection dose, a collar of rubber or other suitable material is stretched around the trunk below the saw kerf to provide a water-tight seal. It is necessary that these collar reservoirs be large enough to hold the chemical dose calculated for an individual tree. A double injection kerf facilitates conduction by inhibiting excessive pitching in a single kerf, which greatly retards absorption and conduction. This method can be used for trees of all sizes and was the one most generally used in the experiments (figs. 8 and 9). The process appears to offer possibilities as a low-cost method of treating selected trees in place. Up to the present time, the useful life of many of the test trees has been as high as 13 years, and they show no signs of decay. Cut, untreated logs left in the forest at the same location have lasted less than 5 years. Figure 10 shows the erection of a demonstration log building to test the durability of chemical-injected logs.

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CONCLUSIONS

In this paper it was not intended to compare the various timber-treating methods or the chemicals used but to suggest the possible use of a simple, effective method by companies having access to standing timber that eventually may be cut for mine use.

Several methods of impregnating a tree have been described, and if experimentation is continued it is likely that a technique for a rapid, low-cost treatment can be developed.

Of the many inpregnating solutions tested by the Forest Insect Laboratory, chromated zinc chloride was found to be one of the most desirable. Also, in these and other tests chromated zinc chlorides has proved to be effective in the treatment of mine timbers.

In impregnating the sap streams of green, standing trees with preservatives, certain advantages are apparent. When the chemical is evenly distributed throughout the sapwood - the part most susceptible to deterioration from rot and fungi - the effectiveness of the treatment is not seriously reduced when the timber is sawed or trimmed before placing in the mine. Much of the mine timber thus treated may be used "as received," as peeling would be unnecessary. In fact, the bark left intact protects against excessive contact with the chemical in handling such timber. This method of treating timber in the forest would make it unnecessary to operate separate timber-treating plants. One or more crews could work in advance of the loggers to create a reserve of treated timber and thus reduce the loss of suitable trees from insect infestation. The treated mine timbers can be stock-piled either in the forest or at the mine without fear of rapid deterioration.

Although zinc chloride has been suggested here for timber treatment, other preferred chemicals could be applied as suggested. Some chemicals, such as ammonium bifluoride, which were more effective in preventing insect infestation in the experiments referred to, are highly toxic and caustic and would be difficult to handle if used extensively.

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